## Exercise - I (Conceptual Questions) Build Up Your Understanding

### WORK

**1.** A force $\vec{F}=\left(4\hat{i}-4\hat{j}-2\hat{k}\right)N$ displaces a particle by $\vec{d}=\left(3\hat{i}+2\hat{j}-2\hat{k}\right)m$, calculate work done.

(1) Zero (2) 8 J (3) 4 J (4) 12 J

**2.** A force $\vec{F}=\left(3\hat{i}+2\hat{j}\right)N$ acts on a body and produces a displacement $\vec{S}=\left(4\hat{i}-\hat{j}+3\hat{k}\right)m$. The work done will be

(1) 13 J (2) 30 J (3) 10 J (4) 20 J

**3.** A particle is moved from a position $\vec{r}_1=(2\hat{i}+\hat{j}-2\hat{k})$ metre to a position $\vec{r}_2=(4\hat{i}+3\hat{j}-\hat{k})$ metre under the action of a force $\vec{F}=(3\hat{i}+2\hat{j}+2\hat{k})$ N.

The work done is equal to :-

(1) 32 J (2) 12 J (3) 24 J (4) 16 J

**4.** A body of mass m is displaced from point A(3, 1, 3) m to point B(1, 2, 1) m under the effect of a force $\vec{F}=(3\hat{i}+2\hat{j}+2\hat{k})$, calculate work done by the force.

(1) 57 J (2) 11 J (3) 0 (4) 22 J

**5.** A person of mass m is standing on one end of a plank of mass M and length L floating in water. The person moves from one end to another and stops. Work done by normal force is –

(1) MgL (2) mgL (3) $\frac{mMgL}{M+m}$ (4) 0

**6.** The work done against gravity in taking 5 kg. mass to 2 m height in 1 s will be :-

(1) 49 J (2) 98 J

(3) 196 J (4) None of these

**7.** A stone of mass m is tied to a string of length $\ell$ at one end and by holding second end it is whirled into a horizontal circle with constant speed v, then work done by the string on the stone will be :–

(1) 0 (2) $\left(\frac{mv^2}{\ell}\right)2\pi\ell$

(3) $(mg)\cdot 2\pi\ell$ (4) $\left(\frac{mv^2}{\ell}\right)\ell$

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**8.** A student of Allen is going from samarth to sabal building holding his bag in his hand. Direct distance between these buildings is 50m. Calculate work done by gravity if mass of bag is 3 kg.

(1) 750 J

(2) 1500 J

(3) Zero

(4) Data insufficient

**9.** You lift a heavy book from the floor of the room and keep it in the book–shelf having a height 2 m. In this process you take 5 seconds. The work done by you will depend upon :-

(1) Mass of the book and time taken.

(2) Weight of the book and height of the book-shelf

(3) Height of the book-shelf and time taken.

(4) Mass of the book, height of the book-shelf and time taken.

**10.** Work done by static friction is :

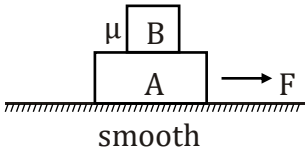
(1) Always zero

(2) Always non-zero

(3) May be zero or non-zero

(4) None of these

**11.** For the system shown in figure both the block A and B are moving together. If coefficient of friction between both the blocks is μ, the work done by friction on block B is :-




(1) Zero (2) Negative

(3) Positive (4) None of these

**12.** A body of mass M tied to a string is lowered at a constant acceleration of (3g/4) through a vertical distance h. The work done by the string will be.....

(1) $\frac{3}{4}$Mgh (2) $\frac{1}{4}$Mgh

(3) $\frac{-3}{4}$Mgh (4) $\frac{-1}{4}$Mgh

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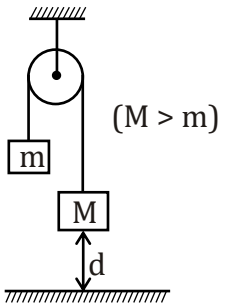
**13.** The net work done by tension in the figure when the bigger block of mass M touches the ground is :-

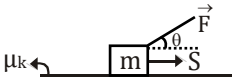



(1) Mgd (2) –(M + m)gd
(3) –mgd (4) Zero

**14.** The work done by the frictional force on a pencil in drawing a complete circle of radius $r = 1/\pi$ metre on the surface by a pencil of negligible mass with a normal pressing force R = 5 N ($\mu$ = 0.5) is :

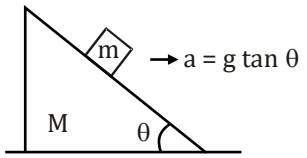
(1) + 4J (2) –3 J (3) – 2 J (4) – 5J

**15.** Find work done by friction for displacement 'S' ?




(1) $\mu_K(mg+F\sin\theta)S$ (2) $-\mu_K(mg+F\sin\theta)S$
(3) $\mu_K(mg-F\sin\theta)S$ (4) $-\mu_K(mg-F\sin\theta)S$

**16.** The whole wedge and block system is moving as shown in the figure. Block of mass m is not slipping on the wedge. Then which of the following statement is correct (surface between M and m is rough) :-

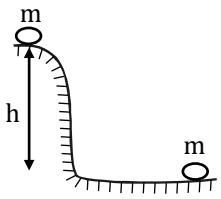



(1) Work done by normal force on block is zero
(2) Work done by friction force on block is not zero
(3) Work done by normal force on block is not zero
(4) None of these

**17.** A particle is made to move from the origin in three spells of equal distances, first along the x-axis, second parallel to y-axis and third parallel to z-axis. Each time the force acting on it has constant magnitude of 50 N and always acts along the direction of motion. Work done by this force in the three spells of motion are equal and total work done in the three spells is 300 J. The final coordinates of the particle will be :-

(1) (2, 2, 2) m (2) (4, 4, 4) m
(3) (6, 6, 6) m (4) (10, 10, 10) m

**18.** An object of mass m is sliding down a hill of arbitrary shape and after travelling a certain horizontal path stops because of friction. The work done that a force must perform to return the object to its initial position along the same path would be:-




(1) 0 (2) mgh
(3) 2mgh (4) None of these

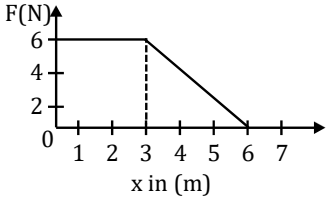
**19.** A force $F = (x^2+3x-5)$ N acts on a 5 kg body along x-axis as a result of which the body gets displaced from x=0 to x=3 m. The work done by the force will be –

(1) 35 J (2) 15 J
(3) 7.5 J (4) 70 J

**20.** A force $F = Kx^3$ acts on a particle at an angle of 60° with the x–axis. The work done in displacing the particle from $x_1$ to $x_2$ will be –

(1) $\frac{kx^3}{3}$ (2) $\frac{k}{3}\left(x_2^2 - x_1^3\right)$
(3) $\frac{k}{8}\left(x_2^4 - x_1^4\right)$ (4) $\frac{k}{4}\left(x_2^4 - x_1^4\right)$

**21.** A force F acting on an object varies with distance x as shown here.
The work done by the force in moving the object from x = 0 to x = 6m is :-




(1) 18.0 J (2) 27 J
(3) 36 J (4) 9.0 J

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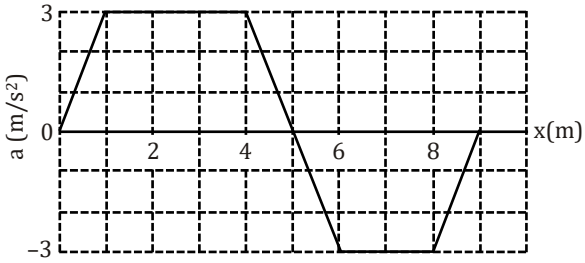
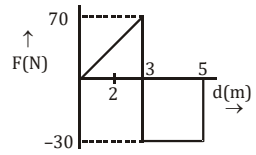
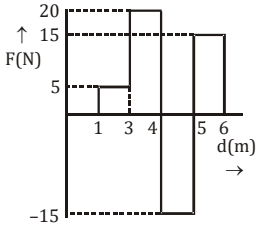
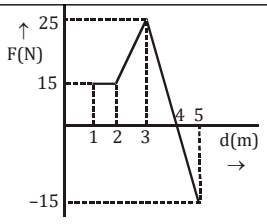
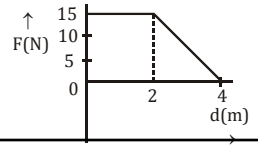
**22.** Figure gives the acceleration of a 4.0 kg body as it moves from rest along x axis while a variable force acts on it from x = 0m to x = 9m. The work done by the force on the body when it reaches
(i) x = 4m and
(ii) x = 7 m shall be as given below




(1) 21 J and 33 J respectively
(2) 21 J and 15 J respectively
(3) 42 J and 60 J respectively
(4) 42 J and 30 J respectively

**23.** Calculate the work done for following F-d curves

| | | |
|---|---|---|
| (A) |   | (P) 30 J |
| (B) |   | (Q) 140 J |
| (C) |   | (R) 45 J |
| (D) |   | |

(1) (A - R); (B - Q); (C - P); (D - R)
(2) (A - R); (B - P); (C - R); (D - Q)
(3) (A - R); (B - P); (C - Q); (D - R)
(4) (A - P); (B - Q); (C - R); (D - P)

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## KINETIC ENERGY & WORK ENERGY THEOREM

**24.** The kinetic energy of a body becomes nine times of its initial value. The new linear momentum will be :-
(1) Four times the initial value
(2) Thrice the initial value
(3) Twice the initial value
(4) Same as the initial value

**25.** If the momentum of a body is increased n times, its kinetic energy increases.
(1) n times (2) 2n times
(3) $\sqrt{n}$ times (4) $n^2$ times

**26.** If the kinetic energy of a body becomes 4 times of its initial kinetic energy, then the momentum of the body will become :-
(1) $2\sqrt{2}$ times (2) $\sqrt{2}$ times
(3) 2 times (4) none of these

**27.** Two bodies of mass 4kg and 9kg have equal K.E. then the ratio of their momentum is :-
(1) 3 : 2 (2) 2 : 3
(3) 4 : 9 (4) 16 : 8

**28.** 2 particles of mass 3 Kg and 5 kg have same momentum, calculate ratio of their K.E.
(1) 5 : 3 (2) 3 : 5
(3) 25 : 9 (4) 9 : 25

**29.** If K.E. of body is increased by 300%. Then % change in its 'P' will be
(1) 100% (2) 41.4%
(3) 17.3% (4) 200%

**30.** If the kinetic energy of a body is increased by 800%, the momentum will increase by :-
(1) 100% (2) 200%
(3) 150% (4) 300%

**31.** If K.E. of a body increases by 3%, then momentum will increase by :-
(1) 1.5% (2) 9%
(3) 3% (4) 2%

**32.** If the momentum of a body increases by 2% then it's kinetic energy :-
(1) increases by 2%
(2) increases by 4%
(3) increases by 8%
(4) increases by 16%

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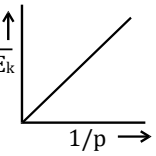
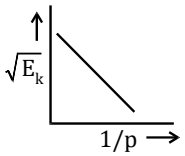
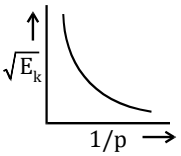
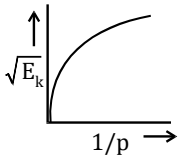
**33.** The graph between $\sqrt{E_k}$ and $\frac{1}{p}$ is

($E_K$ = kinetic energy and p = momentum) –

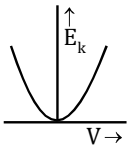
(1) 

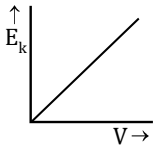

(2) 

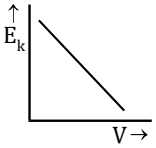

(3) 

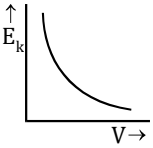

(4) 


**34.** The graph between kinetic energy $E_K$ and velocity V is –

(1) 


(2) 


(3) 


(4) 


**35.** A constant force F is applied to a body of mass m moving with initial velocity u. If after the body undergoes a displacement S, its velocity becomes v, then the total work done is :-

(1) $m[v^2 + u^2]$ (2) $\frac{m}{2}[u^2 + v^2]$

(3) $\frac{m}{2}[v^2 - u^2]$ (4) $m[v^2 - u^2]$

**36.** A body of mass 6 kg is acted upon by a force which causes displacement in it given as $S = \frac{t^3}{4}$ metres where 't' is time. The work done by the force in 2 seconds is :-

(1) 18 J (2) 9 J (3) 27 J (4) 16 J

**37.** A force acts on a 20 g particle in such a way that the position of the particle as a function of time is given by $x = 2t - 3t^2 + 2t^3$, where x is in metre and t is in second. The work done during the first 3 second is :-

(1) 5.28 J (2) 28.8 J (3) 14.4 J (4) 7.2 J

**38.** A ball of mass 1 kg and another of mass 3 kg are dropped together from a 60 feet tall building. After a fall of 30 feet each towards earth, their respective kinetic energies will be in the ratio of :-

(1) 1 : 3 (2) 1 : 2 (3) $1 : \sqrt{3}$ (4) $\sqrt{3} : 1$

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**39.** A 2 kg ball is thrown up with an initial speed 16 m/s and reaches a maximum height of 10 m. How much energy is dissipated by air drag acting on the ball during the ascent ?

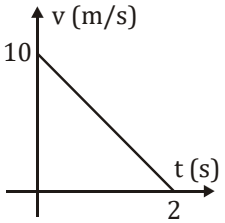
(1) 40 J (2) 56 J (3) 36 J (4) 72 J

**40.** Three particles A, B and C are projected from the top of a tower with the same speed. A is thrown straight upwards, B straight down and C horizontally. They hit the ground with speeds $V_A$, $V_B$ and $V_C$ then:

(1) $V_A = V_B > V_C$ (2) $V_A = V_B = V_C$

(3) $V_A > V_B = V_C$ (4) $V_B > V_C > V_A$

**41.** Velocity–time graph of a particle of mass 2 kg moving in a straight line is as shown in figure. Work done by all the forces acting on the particle is :




(1) 100 J (2) –100 J (3) –200 J (4) 200 J

## CONSERVATIVE FORCE & POTENTIAL ENERGY

**42.** Which of the following statements is not true for work done by conservative forces :–

(1) It does not depend on path

(2) It is equal to the difference of initial and final potential energy function

(3) It can be recovered completely

(4) None of the above

**43.** Which of the following statement is incorrect for a conservative field ?

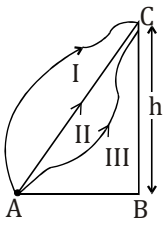
(1) Work done in going from initial to final position is equal to change in kinetic energy of the particle.

(2) Work done depends on path but not on initial and final positions.

(3) Work done does not depend on path but depends only on initial and final positions

(4) Work done on a particle in the field for a round trip is zero.

**44.** As shown in the diagram a particle is to be carried from point A to C via paths (I), (II) and (III) in gravitational field, then which of the following statements is correct :–




(1) Work done is same for all the paths
(2) Work done is minimum for path (II)
(3) Work done is maximum for path (I)
(4) None of the above

**45.** Which of the following is a non conservative force :–
(1) Electric force
(2) Gravitational force
(3) Spring force
(4) Viscous force

**46.** The relation between conservative force and potential energy U is given by :–

(1) $F = \frac{dU}{dx}$ (2) $F = \int U dx$

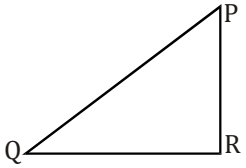
(3) $F = -\frac{dU}{dx}$ (4) $F = \frac{dU}{dx}$

**47.** A 10 kg satellite completes one revolution around the earth at a height of 100 km in 108 minutes. The work done by the gravitational force of earth will be –

(1) 108 × 100 × 10 J (2) $\frac{108 \times 10}{100}$ J

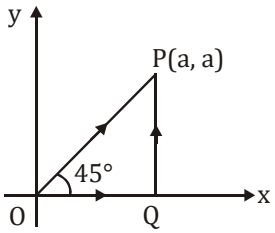
(3) 0 J (4) $\frac{100 \times 10}{108}$ J

**48.** For the path PQR in a conservative force field the amount of work done in carrying a body from P to Q and from Q to R are 15 Joule and 5 Joule respectively. The work done in carrying the body from P to R will be –




(1) 20 J (2) 10 J (3) 5 J (4) Zero

**49.** A particle is moved from (0, 0) to (a, a) under a force $\vec{F} = (3\hat{i} + 4\hat{j})$ from two paths. Path 1 is OP and path 2 is OQP. Let $W_1$ and $W_2$ be the work done by this force in these two paths. Then :




(1) $W_1 = W_2$ (2) $W_1 = 2W_2$
(3) $W_2 = 2W_1$ (4) $W_2 = 4W_1$

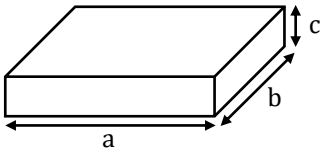
**50.** A body of mass 3 kg falls from a height of 20 m. What is the loss in potential energy :-
(1) 400 J (2) 300 J
(3) 200 J (4) 600 J

**51.** The mass of a bucket full of water is 13 kg. It is being pulled up from a 10 m deep well. Due to a hole in the bucket 4 kg water flows out of the bucket. The work done in drawing the bucket out of the well will be ($g = 10 m/s^2$)–
(1) 900 J (2) 1300 J
(3) 1100 J (4) 1700 J

**52.** A uniform chain of length L and mass M is lying on a smooth table and $\frac{1}{3}$rd of its length is hanging down from the edge of the table. If g is the acceleration due to gravity, the work done to pull the hanging part on the table is :-

(1) MgL (2) $\frac{MgL}{18}$ (3) $\frac{MgL}{9}$ (4) $\frac{2MgL}{9}$

**53.** A brick has 3 sides a, b, c {a > b > c}. The brick can be kept on ground on any face. The work required to be done to move slowly from minimum potential energy situation to maximum potential energy situation of brick is :




(1) $mg\left(\frac{a}{2} - \frac{b}{2}\right)$ (2) $mg\left(\frac{a}{2} - \frac{c}{2}\right)$

(3) $mg\left(\frac{b}{2} - \frac{c}{2}\right)$ (4) $mg\left(\frac{a+c}{2} - \frac{b}{2}\right)$

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**54.** If a spring extends by x on loading then energy stored in the spring is :- (T is tension in the spring, K = spring constant)

(1) $\frac{T^2}{2x}$ (2) $\frac{T^2}{2K}$ (3) $\frac{2K}{T^2}$ (4) $\frac{2T^2}{K}$

**55.** A spring of force constant 1000 N/m has an extension of 15 cm. The work done in extending it from 15 cm to 25 cm is :-

(1) 16 J (2) 8 J (3) 32 J (4) 20 J

**56.** In stretching a spring by 5 cm energy stored is given by U, then the energy stored if the spring is stretched by 10 cm will be :-

(1) U (2) 5U (3) 4U (4) 25U

**57.** 5 J of work is required to stretch a spring through 5 cm beyond its unstretched length. The extra work required to stretch it through additional 5 cm shall be

(1) 5 J (2) 10 J (3) 15 J (4) 25 J

## CONSERVATION OF MECHANICAL ENERGY

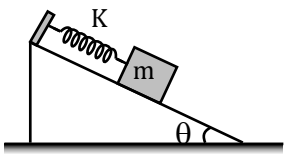
**58.** A body is dropped from a height h. When loss in its potential energy is U then its velocity is v. The mass of the body is –

(1) $\frac{U^2}{2v}$ (2) $\frac{2v}{U}$ (3) $\frac{2v}{U^2}$ (4) $\frac{2U}{v^2}$

**59.** A block of mass 4 kg is moving on a frictionless horizontal surface with velocity 2m/s and comes to rest after pressing a spring. If the force constant of the spring is 100 N/m then the compression in the spring will be –

(1) 0·8 m (2) 1·6 m
(3) 0·4 m (4) 3·2 m

**60.** A system of smooth inclined plane and block is shown in figure block is released when the spring in its natural length. Maximum elongation in the spring will be :-




(1) $\frac{2mg\sin\theta}{K}$ (2) $\frac{mg\sin\theta}{K}$
(3) $\frac{4mg\sin\theta}{K}$ (4) $\frac{mg\sin\theta}{2K}$

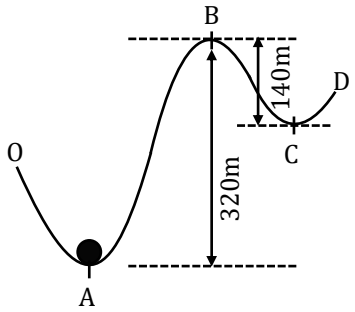
**61.** A ball of mass 2 kg is released from the tower of Pisa. The kinetic energy generated in it after falling through 10m will be –

(1) 20 J (2) 196 J (3) 49 J (4) 98 J

**62.** A stone is projected vertically up to reach maximum height 'h'. The ratio of its kinetic energy to potential energy, at a height $\frac{h}{5}$ will be :-

(1) 5 : 4 (2) 4 : 5
(3) 1 : 4 (4) 4 : 1

**63.** Track OABCD (as shown is figure) is smooth and fixed in vertical plane. What minimum speed has to be given to a particle lying at point A, so that it can reach point C ?

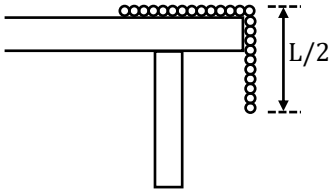



(1) 60 m/s (2) 100 m/s
(3) 70 m/s (4) 80 m/s

**64.** A projectile is fired at $30^0$ with momentum p, neglecting friction, the change in kinetic energy, when it returns back to the ground, will be :-

(1) zero (2) 30 %
(3) 60 % (4) 100 %

**65.** A uniform chain (mass M, length L) is released from rest from a smooth horizontal surface as shown in the figure. Velocity of the chain at the instant it completely comes out of the table will be.




(1) $V = \sqrt{gL}$ (2) $V = \sqrt{\frac{3gL}{4}}$

(3) $V = \frac{1}{2}\sqrt{5gL}$ (4) $V = \frac{1}{2}\sqrt{gL}$

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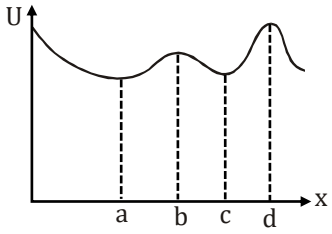
**66.** Figure shows a plot of the potential energy as a function of x for a particle moving along the x-axis:-




Which of the following statement(s) is/are true?

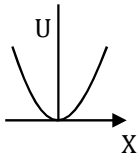
(1) a, c, and d are points of equilibrium

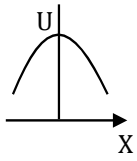
(2) a is a point of stable equilibrium

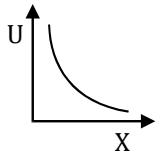
(3) b is a unstable equilibrium point

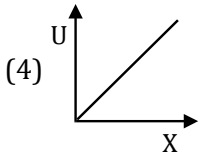
(4) All of the above

**67.** The graph between potential energy U and displacement X in the state of stable equilibrium will be –

(1) 


(2) 


(3) 


(4) 


**68.** A particle moves in a potential region given by $U = 2x^2 - 2x + 100$ J. Its state of equilibrium will be at :-

(1) x = 25 m (2) x = 0·25 m

(3) x = 0·05 m (4) x = 0·5 m

**69.** If $F = 2x^2 - 3x - 2$, then choose correct option

(1) $x = -\frac{1}{2}$ is position of stable equilibrium

(2) x = 2 is position of stable equilibrium

(3) $x = -\frac{1}{2}$ is position of unstable equilibrium

(4) x = 2 is position of neutral equilibrium

**70.** If the potential energy of system of two molecules is given by, $U = \frac{A}{r^{12}} - \frac{B}{r^6}$

then at equilibrium position, its potential energy is equal to :

(1) $\frac{A^2}{4B}$ (2) $-\frac{B^2}{4A}$ (3) $\frac{2B}{A}$ (4) 3A

**71.** A particle in a certain conservative force field has a potential energy given by $U = \frac{2x^2y}{z^2}$. The force exerted on it is

(1) $\left(\frac{4xy}{z^2}\right)\hat{i} + \left(\frac{2x^2}{z^2}\right)\hat{j} + \left(\frac{4x^2y}{z^3}\right)\hat{k}$

(2) $-\left(\frac{4xy}{z^2}\right)\hat{i} - \left(\frac{2x^2}{z^2}\right)\hat{j} + \left(\frac{4x^2y}{z^3}\right)\hat{k}$

(3) $-\left(\frac{4xy}{z^2}\right)\hat{i} - \left(\frac{2x^2}{z^2}\right)\hat{j} - \left(\frac{4x^2y}{z^3}\right)\hat{k}$

(4) $\left(\frac{4xy}{z}\right)\hat{i} + \left(\frac{2x^2}{z}\right)\hat{j} - \left(\frac{4x^2y}{z^2}\right)\hat{k}$

## POWER

**72.** An electric motor produces a tension of 5000N in a load lifting cable and rolls it at the rate of 2 m/s. The power of the motor is –

(1) 10 kW (2) 15 kW

(3) 25 kW (4) $9 \times 10^3$ hp

**73.** A motor of 50 hp is moving a car with a constant velocity of 36 km/hour. The forward force exerted by the engine on the car is – (1 hp = 746 W)

(1) $3{\cdot}73 \times 10^3$ N

(2) $3{\cdot}73 \times 10^2$ N

(3) $3{\cdot}73 \times 10^1$ N

(4) None of the above

**74.** A car is moving with a speed of 36 Km/hr. If the car engine generates 7 kilowatt power, then the resistance in the path of motion of the car will be –

(1) 300 newton (2) 700 newton

(3) Zero (4) 500 newton

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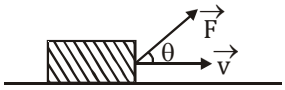
**75.** A constant force $\vec{F}$ is acting on a body of mass m moving with constant velocity $\vec{v}$ as shown in the figure. The power P exerted is




(1) $Fv\cos\theta$ (2) $\frac{F\cos\theta}{mg}$

(3) $\frac{Fmg\cos\theta}{v}$ (4) $\frac{mg\sin\theta}{F}$

**76.** A force $\vec{F}=\left(3\hat{i}+4\hat{j}\right)$N acts on a 2 kg movable object that moves from an initial position $\vec{d_i}=\left(-3\hat{i}-2\hat{j}\right)$ m to final position $\vec{d_f}=\left(5\hat{i}+4\hat{j}\right)$ in 6s. The average power delivered by the force during the interval is equal to :

(1) 8 watt (2) $\frac{50}{6}$ watt

(3) 15 watt (4) $\frac{50}{3}$ watt

**77.** Two men with weights in the ratio 2 : 3 run up a staircase in times in the ratio 5 : 9. The ratio of power of first to that of second is –

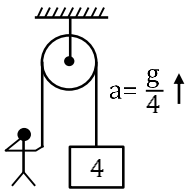
(1) $\frac{6}{5}$ (2) $\frac{5}{6}$ (3) $\frac{10}{27}$ (4) $\frac{18}{15}$

**78.** A crane lifts 200 kg weight from earth's surface upto a height of 3m in 4 seconds. The average power generated by it will be – ($g = 9.8\ m/sec^2$)

(1) 1470 W (2) 735 W

(3) 2940 W (4) 0 W

**79.** Calculate power generated by tension in the string in first 2 seconds of motion :-




(1) 250 W (2) 125 W

(3) 500 W (4) 750 W

**80.** What average horsepower is developed by a 50kg man while climbing in 10s flight of stairs that rises 10 m vertically ?

(1) 0.66 hp (2) 1.26 hp

(3) 1.8 hp (4) 2.1 hp

**81.** A 2.0 hp motor pumps out water from a well of depth 8 m and fills a water tank of volume 1492 liters at a height of 16 m from the ground. The running time of the motor to fill the empty water tank is ($g = 10 m/s^2$) :-

(1) 50 minutes (2) 10 minutes

(3) 4 minutes (4) 20 minutes

**82.** Water is falling on the blades of a turbine at a rate of 50 kg/s from a certain spring. If the height of the spring be 50 metres, the power transferred to the turbine will be :-

(1) 100 KW (2) 25 KW

(3) 5 KW (4) 250 KW

**83.** If the force applied is F and the velocity gained is v, then the average power developed is :-

(1) $\frac{F}{v}$ (2) $\frac{v}{F}$

(3) $\frac{Fv}{2}$ (4) $Fv^2$

**84.** A small body of mass 'm' is located in a horizontal plane at point O. The body accelerates uniformly and acquires horizontal velocity u then mean power developed by the friction force during the whole time of motion, if friction coefficient is k. :-

(1) $\frac{3mu}{4kg}$ (2) $\frac{5}{6}$mukg

(3) $\frac{1}{2}$mukg (4) $\frac{12}{7}$mukg

**85.** A time varying power P = 2t is applied on a particle of mass 3kg. The change in kinetic energy of the particle at t = 4 sec is :-

(1) 4 J (2) 8 J

(3) 16 J (4) 24 J

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**86.** Power supplied to a particle of mass 2 kg varies with time as $P = \frac{3t^2}{2}$ watt. Here t is in second. If velocity of particle at t = 0 is v = 0, the velocity of particle at time t = 2 s will be :-

(1) 1 m/s (2) 4 m/s

(3) 2 m/s (4) $2\sqrt{2}$ m/s

**87.** A body of mass m starting from rest from origin moves along x-axis with constant power P. Calculate relation between velocity and distance :-

(1) $x \propto v^{1/2}$ (2) $x \propto v^2$

(3) $x \propto v$ (4) $x \propto v^3$

**88.** A body of mass 2 kg is moving up an inclined plane rising 1 in 30 with velocity 60 m/sec. If efficiency is 40%, then calculate power required.

(1) 60 W (2) 40 W

(3) 100 W (4) 20 W

**89.** A pump is used to deliver water at a certain rate from a given pipe. To obtain n times water from the same pipe in the same time, by what factor, the force of the motor should be increased?

(1) n times (2) $n^2$ times

(3) $n^3$ times (4) $\frac{1}{n}$ times

## EXERCISE-I (Conceptual Questions) ANSWER KEY

| Question | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Answer | 2 | 3 | 2 | 3 | 4 | 2 | 1 | 3 | 2 | 3 | 3 | 4 | 4 | 4 | 4 |
| Question | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| Answer | 3 | 1 | 3 | 3 | 3 | 2 | 4 | 3 | 2 | 4 | 3 | 2 | 1 | 1 | 2 |
| Question | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 |
| Answer | 1 | 2 | 3 | 1 | 3 | 3 | 3 | 1 | 2 | 2 | 2 | 4 | 2 | 1 | 4 |
| Question | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 |
| Answer | 3 | 3 | 1 | 1 | 4 | 3 | 2 | 2 | 2 | 4 | 3 | 3 | 4 | 3 | 1 |
| Question | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 |
| Answer | 2 | 4 | 4 | 1 | 2 | 4 | 1 | 4 | 1 | 2 | 2 | 1 | 1 | 2 | 1 |
| Question | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | |
| Answer | 1 | 1 | 1 | 2 | 1 | 3 | 2 | 3 | 3 | 3 | 3 | 4 | 3 | 2 | |

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## Exercise - II (Previous Year Questions) AIPMT/NEET

### AIPMT 2006

**1.** 300 J of work is done in sliding a 2 kg block up an inclined plane of height 10m. The work done against friction is :-
(take g = 10 m/s$^2$)
(1) zero (2) 100 J
(3) 200 J (4) 300 J

**2.** A body of mass 3 kg is under a constant force which causes a displacement s in metres in it, given by the relation $s = \frac{1}{3}t^2$, where t is in seconds. Work done by the force in 2 seconds is:-
(1) $\frac{5}{19}$ J (2) $\frac{3}{8}$ J (3) $\frac{8}{3}$ J (4) $\frac{19}{5}$ J

### AIPMT 2009

**3.** A block of mass M is attached to the lower end of a vertical spring. The spring is hung from a ceiling and has force constant value k. The mass is released from rest with the spring initially unstretched. The maximum extension produced in the length of the spring will be :-
(1) Mg/2k (2) Mg/k
(3) 2Mg/k (4) 4Mg/k

**4.** An engine pumps water continuously through a hose. Water leaves the hose with a velocity v and m is the mass per unit length of the water jet. What is the rate at which kinetic energy is imparted to water :-
(1) $\frac{1}{2}m^2v^2$ (2) $\frac{1}{2}mv^3$
(3) $mv^3$ (4) $\frac{1}{2}mv^2$

**5.** A body of mass 1 kg is thrown upwards with a velocity 20 m/s. It momentarily comes to rest after attaining a height of 18 m. How much energy is lost due to air friction ? (g = 10 m/s$^2$) :-
(1) 10 J (2) 20 J (3) 30 J (4) 40 J

### AIPMT 2010

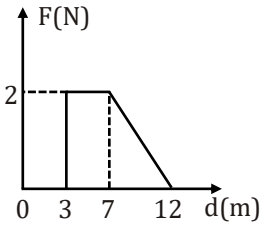
**6.** An engine pumps water through a hose pipe. Water passes through the pipe and leaves it with a velocity of 2 m/s. The mass per unit length of water in the pipe is 100 kg/m. What is the power of the engine?
(1) 800 W (2) 400 W
(3) 200 W (4) 100 W

### AIPMT 2011

**7.** The potential energy of a system increases if work is done :-
(1) Upon the system by a nonconservative force
(2) By the system against a conservative force
(3) By the system against a nonconservative force
(4) Upon the system by a conservative force

**8.** A body projected vertically from the earth reaches a height equal to earth's radius before returning to the earth. The power exerted by the gravitational force is greatest :-
(1) At the highest position of the body
(2) At the instant just before the body hits the earth
(3) It remains constant all through
(4) At the instant just after the body is projected

**9.** Force F on a particle moving in a straight line varies with distance d as shown in the figure. The work done on the particle during its displacement of 12 m is :




(1) 18 J (2) 21 J
(3) 26 J (4) 13 J

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**AIPMT (Pre) 2012**

**10.** The potential energy of a particle in a force field is : $U = \frac{A}{r^2} - \frac{B}{r}$

where A and B are positive constants and r is the distance of particle from the centre of the field. For stable equilibrium, the distance of the particle is :

(1) A/B (2) B/A
(3) B/2A (4) 2A/B

**AIPMT (Mains) 2012**

**11.** A car of mass m starts from rest and accelerates so that the instantaneous power delivered to the car has a constant magnitude $P_0$. The instantaneous velocity of this car is proportional to :-

(1) $t^{-1/2}$ (2) $t/\sqrt{m}$ (3) $t^2P_0$ (4) $t^{1/2}$

**NEET (UG) 2013**

**12.** A uniform force of $(3\hat{i}+\hat{j})$ newton acts on a particle of mass 2kg. Hence the particle is displaced from position $(2\hat{i}+k)$ meter to position $(4\hat{i}+3\hat{j}-k)$ meter. The work done by the force on the particle is :-

(1) 15 J (2) 9 J (3) 6 J (4) 13 J

**AIPMT 2015**

**13.** A block of mass 10 kg, moving in x direction with a constant speed of 10 m/s, is subjected to a retarding force F = 0.1x J/m during its travel from x = 20 m to 30 m. Its final KE will be :

(1) 450 J (2) 275 J
(3) 250 J (4) 475 J

**14.** A particle of mass m is driven by a machine that delivers a constant power k watts. If the particle starts from rest the force on the particle at time t is :-

(1) $\sqrt{mk}\,t^{-1/2}$ (2) $\sqrt{2mk}\,t^{-1/2}$

(3) $\frac{1}{2}\sqrt{mk}\,t^{-1/2}$ (4) $\sqrt{\frac{mk}{2}}\,t^{-1/2}$

**NEET-I 2016**

**15.** A body of mass 1 kg begins to move under the action of a time dependent force $\vec{F}=(2t\,\hat{i}+3t^2\hat{j})N$, where $\hat{i}$ and $\hat{j}$ are unit vectors along x and y axis. What power will be developed by the force at the time t ?

(1) $(2t^2 + 3t^3)W$ (2) $(2t^2 + 4t^4)W$
(3) $(2t^3 + 3t^4)W$ (4) $(2t^3 + 3t^5)W$

**NEET-II 2016**

**16.** A particle moves from a point $(-2\hat{i}+5\hat{j})$ to $(4\hat{j}+3\hat{k})$ when a force of $(4\hat{i}+3\hat{j})$ N is applied. How much work has been done by the force ?

(1) 5 J (2) 2 J
(3) 8 J (4) 11 J

**NEET(UG) 2017**

**17.** Consider a drop of rain water having mass 1 g falling from a height of 1 km. It hits the ground with a speed of 50 m/s. Take 'g' constant with a value 10 m/s$^2$. The work done by the (i) gravitational force and the (ii) resistive force of air is :-

(1) (i) 1.25 J (ii) – 8.25 J
(2) (i) 100 J (ii) 8.75 J
(3) (i) 10 J (ii) – 8.75 J
(4) (i) –10 J (ii) – 8.25 J

**NEET(UG) 2019**

**18.** A force F = 20 + 10y acts on a particle in y-direction where F is in newton and y in meter. Work done by this force to move the particle from y = 0 to y = 1 m is :

(1) 30 J (2) 5 J
(3) 25 J (4) 20 J

**NEET(UG) 2019 (Odisha)**

**19.** An object of mass 500g, initially at rest is acted upon by a variable force, whose X component varies with x in the manner shown. The velocities of the object at point X = 8 m and X =12 m, would be the respective values of (nearly)

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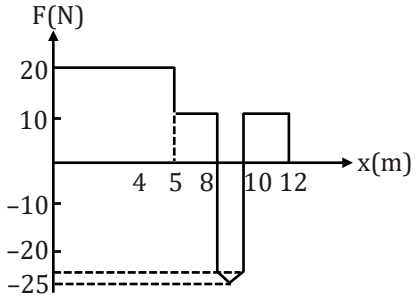



(1) 18 m/s and 24.4 m/s
(2) 23 m/s and 24.4 m/s
(3) 23 m/s and 20.6 m/s
(4) 18 m/s and 20.6 m/s

**NEET (UG) 2021**

**20.** A particle is released from height S from the surface of the Earth. At a certain height its kinetic energy is three times its potential energy. The height from the surface of earth and the speed of the particle at that instant are respectively :

(1) $\frac{S}{4}, \frac{3gS}{2}$ (2) $\frac{S}{4}, \frac{\sqrt{3gS}}{2}$

(3) $\frac{S}{2}, \frac{\sqrt{3gS}}{2}$ (4) $\frac{S}{4}, \sqrt{\frac{3gS}{2}}$

**21.** Water falls from a height of 60 m at the rate of 15 kg/s to operate a turbine. The losses due to frictional force are 10% of the input energy. How much power is generated by the turbine? ($g = 10\ m/s^2$)

(1) 10.2 kW (2) 8.1 kW
(3) 12.3 kW (4) 7.0 kW

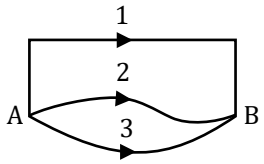
**NEET (UG) 2022**

**22.** An electric lift with a maximum load of 2000 kg (lift + passengers) is moving up with a constant speed of 1.5 $ms^{-1}$. The frictional force opposing the motion is 3000 N. The minimum power delivered by the motor to the lift in watts is: ($g = 10\ ms^{-2}$)

(1) 20000 (2) 34500
(3) 23500 (4) 23000

**RE-NEET (UG) 2022**

**23.** A gravitational field is present in a region and a mass is shifted from A to B through different paths as shown. If $W_1$, $W_2$ and $W_3$ represent the work done by the gravitational force along the respective paths, then :




(1) $W_1 = W_2 = W_3$
(2) $W_1 > W_2 > W_3$
(3) $W_1 > W_3 > W_2$
(4) $W_1 < W_2 < W_3$

## EXERCISE-II (Previous Year Questions) ANSWER KEY

| Question | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Answer | 2 | 3 | 3 | 2 | 2 | 1 | 2 | 2 | 4 | 4 | 4 | 2 | 4 | 4 | 4 |
| Question | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | | | | | | | |
| Answer | 1 | 3 | 3 | 3 | 4 | 2 | 2 | 1 | | | | | | | |

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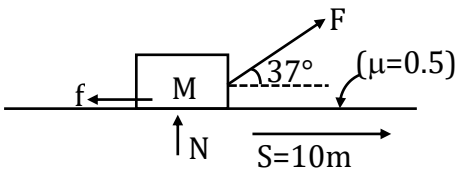
## Exercise - III (Analytical Questions) Master Your Understanding

**1.** A block of mass M = 10kg is dragged 10m by force F = 100N on rough horizontal surface ($\mu = 0.5$)




| Force on block | | Work done by force on block | |
|---|---|---|---|
| A | Applied (F) | P | Zero |
| B | Normal (N) | Q | 600 J |
| C | Friction (f) | R | 800 J |
| D | Net resultant ($F_{net}$) | S | – 200 J |

Match the column

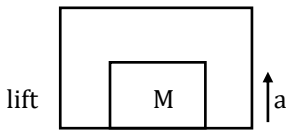
(1) [(A – Q), (B – P), (C – S), (D – R)]

(2) [(A – R), (B – P), (C – S), (D – Q)]

(3) [(A – P), (B – Q), (C – R), (D – S)]

(4) [(A – S), (B – R), (C – Q), (D – P)]

**2.** Block of mass M =10kg is kept inside a lift, which starts motion from rest in vertical upward direction with uniform acceleration ($a = 2m/sec^2$)




| Power delivered to block by force | | Power (in watt) | |
|---|---|---|---|
| A | By normal at 5 sec | P | – 500 |
| B | By normal in 5 sec | Q | 600 |
| C | By Mg (gravity) at 5 sec | R | – 1000 |
| D | By Mg (gravity) in 5 sec | S | 1200 |

Match the column

(1) [(A – P), (B – Q), (C – R), (D – S)]

(2) [(A – Q), (B – S), (C – R), (D – P)]

(3) [(A – S), (B – Q), (C – P), (D – R)]

(4) [(A – S), (B – Q), (C – R), (D – P)]

**3.** Select the correct statements –

(a) Work done by conservative force along closed path is zero.

(b) A body with negative energy can't have linear momentum

(c) Net work done by all the internal force of a system is independent of choice of reference frame

(d) Work done by a non conservative force is always negative

(1) a, b and c (2) a and c

(3) a, b and d (4) All

**4.** Select the correct statements –

(a) Potential energy is defined only for gravitational force.

(b) Potential energy can be associated with frictional force.

(c) Work done by spring force is equal to change in potential energy of the spring.

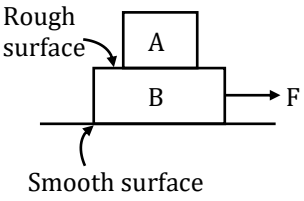
(1) a and b

(2) a and c

(3) all

(4) none of these

**5.**




If both blocks A and B are moving together, then select correct statements –

(a) Work done by the friction on block 'A' is zero

(b) Work done by the friction on block 'A' is positive

(c) Work done by the friction on block 'B' is negative

(d) Work done by friction forces on system (A) and (B) are zero

(1) a, c and d (2) b, c and d

(3) a and d (4) none of these

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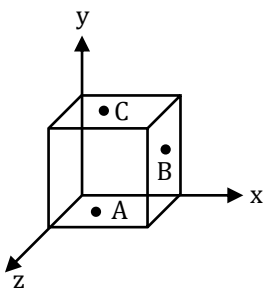
**6.** For a system of particles –
(a) The work done by all external forces is equal to change in kinetic energy
(b) The work done by all forces is equal to change in mechanical energy
Select the correct statements :
(1) only a
(2) only b
(3) both a and b
(4) none of these

**7.** Given below are two statements: one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.
**Assertion (A) :** Kinetic energy of a system can be increased without applying external force on the system.
**Reason (R) :** If external forces are absent then work done by internal forces is equal to change in kinetic energy.
In the light of the above statements, choose the most appropriate answer from the options given below:
(1) Both **(A)** and **(R)** are true and **(R)** is the correct explanation of **(A)**.
(2) Both **(A)** and **(R)** are true and **(R)** is NOT the correct explanation of **(A)**.
(3) **(A)** is true but **(R)** is false.
(4) **(A)** is false but **(R)** is true.

**8.** Given below are two statements: one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.
**Assertion (A) :** Work done is positive when force acts in the direction of displacement.
**Reason (R) :** Work done by frictional force cannot be positive.
In the light of the above statements, choose the most appropriate answer from the options given below:
(1) Both **(A)** and **(R)** are true and **(R)** is the correct explanation of **(A)**.
(2) Both **(A)** and **(R)** are true and **(R)** is NOT the correct explanation of **(A)**.
(3) **(A)** is true but **(R)** is false.
(4) **(A)** is false but **(R)** is true.

**9.** A particle is shifted from A to B and then from B to C where A, B and C are the midpoints of the corresponding faces of a cube of side 2m. If a force $\vec{F}=(3\hat{i}+4\hat{j}-5\hat{k})N$ is continuously acting on the particle, then select incorrect alternative




(1) work done from A to B is 7 J
(2) work done from B to C is 1 J
(3) work done A to C is 8 J
(4) force $\vec{F}$, is nonconservative force

**10.** **Statement : I** : Two balls of different masses are thrown vertically upwards with same speed. They will pass through their point of projection in the downward direction with the same speed in absence of air resistance.
**and**
**Statement II** : In absence of air resistance, the mechanical energy of a projectile is conserved.
(1) Statement-I is true, statement-II is true and statement-II is correct explanation for statement-I.
(2) Statement-I is true, statement-II is true and statement-II is NOT the correct explanation for statement-I.
(3) Statement-I is true, statement-II is false.
(4) Statement-I is false, statement-II is true.

**11.** Assume that in space potential energy U-depends on x-coordinate only by :

$$U = (x-3)^2(2-x)$$

A mass m can be kept on x-axis. In each position indicated in column-I, comment on the situation from column-II.

| **Column I** | **Column II** |
|---|---|
| (A) x = 7/3 | (P) Stable equilibrium |
| (B) x = 2 | (Q) Unstable equilibrium |
| (C) x = 3 | (R) Neutral equilibrium |
| | (S) Not in equilibrium |

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Options :-

(1) A → P, B → S, C → R

(2) A → S, B → P, C → Q

(3) A → P, B → S, C → Q

(4) A → Q, B → S, C → P

**12.** The potential energy (in joules) function of a particle in a region of space is given as :

$$U = (2x^2 + 3y^3 + 2z)$$

Here x, y and z are in metres. Find the magnitude of x component of force (in newton) acting on the particle at point P (1m, 2m, 3m).

(1) 4 (2) 2 (3) 6 (4) None

## EXERCISE-III (Analytical Questions) ANSWER KEY

| Question | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Answer | 2 | 4 | 2 | 4 | 2 | 4 | 1 | 3 | 4 | 1 | 3 | 1 |

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# Important Notes

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